Probabilistic Quantitative Snowfall Forecast (PQSF) Product Description Document

Part I - Mission Connection

The Probabilistic Quantitative Snowfall Forecast (PQSF) displays the probability that select snowfall amounts will occur in two pre-determined metropolitan locations in the Buffalo, NY County Warning Area (CWA) during the first 12-hour period of the upcoming forecast.

Quantitative snowfall forecasts are one of the most difficult challenges facing the operational meteorologist. This challenge is heightened downwind of the Great Lakes, where tremendous disparities in snowfall occur over a very small temporal and spatial scales. Two large metropolitan centers, Buffalo and Rochester, are located in the NWS Buffalo County Warning Area (CWA) and are often directly impacted by large snowfall totals. These locations were chosen for verification. The forecast product will cover approximately a 10-mile radius from each city so that a good portion of the metropolitan area is included.

Using recent advances in technology and communications, forecasters can now objectively convey their confidence in the prediction of snowfall amounts. Specifically, forecasters will strive to accomplish the following goals through this product.

- improve communication of first period forecast information for snowfall potential.
- provide all users an objective picture of the potential for extreme snowfall amounts.
- increase the public's awareness of the various scenarios that the impending storm might take.

The PQSF will be available over INTERNET for the general public. However, it is primarily directed toward planning officials in each metro area including emergency managers, transportation and highway departments, snow clearing operations and school officials.

The PQSF product will be displayed as a bar graph depicting of the probability that certain snowfall ranges could occur. This is a simple yet effective way of presenting the possible scenarios at a quick glance. The spread across the bar graph quickly conveys the confidence that the forecaster has in each snowfall event that is forecast. As a result, all users will gain important value added information that cannot be conveyed in standard NWS products.

Comments

We are always seeking ways to improve our products based on user feedback. Comments on the PQSF project can be addressed to the email listed below, or to our office address.

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National Weather Service 587 Aero Drive Buffalo, NY 14225

Experimental Feedback Period: November 1 2005 through March 30, 2006

Part II - Technical Description

What is the Probabilistic Quantitative Snowfall Forecast?

The Probabilistic Quantitative Snowfall Forecast (PQSF) conveys the chances that certain snowfall amounts will occur in select locations during the first 12-hour period of the ensuing forecast. The two largest metropolitan centers in western New York, Buffalo and Rochester, were chosen for this study. The PQSF is a good example of the NWS initiative to present forecast information in simple graphical formats. The product is presented over INTERNET as a histogram that displays the percentage chance that certain snowfall amounts will occur in Buffalo and Rochester (Fig 1). The forecast will be produce twice daily and made available through INTERNET at approximately 4AM and 4PM.

The snowfall categories were chosen for the most part in accordance with the Nested Grid Model (NGM) Model Output Statistics (MOS) product so that forecasters could compare and verify their products against an established procedure. This is an important part of the process to determine if the product will have any additional skill over standard model guidance.

The PQSF 12 hour snowfall format is approximately the same as the standard MOS categories with an exception as noted below. The categories are:

- 0 to trace
- 0.1 to 2.0 inches
- 2.1 to 4 inches
- 4.1 to 6 inches
- 6.1 to 12 inches * (standard NGM MOS category is "more than 6 inches")
- more than 12 inches *

The exception occurs over the last two categories. In the part of the country where lake effect snows are common, there is a real threat for greater than a foot of snow in a 12-hour period of time. The difference between a 6-inch event and a 12-inch event is critical to snow removal efforts and the subsequent impact on the public. Therefore, the last two categories were changed to accommodate these possibilities:

Verification of the Forecast Product

An outgrowth of the PQSF product will be verification of the forecast against NGM MOS guidance. In addition, forecasts will be verified against ETA model grid point BUFR files. Because snowfall is not explicitly produced from that output, liquid precipitation is tallied through the 12-hour forecast period and modified with a standard 10:1 ratio to produce snowfall amounts.

By necessity there will be a slight disparity to the verification points. The ETA and NGM MOS forecasts verify for a point, namely the Buffalo and Rochester airports. The PQSF product will not have much value if it is designed just for the airport locations. Therefore, it was decided that

the PQSF forecast would be valid for a 10 mile radius from the center of each city. In this way, officials would at least have a good idea that a portion of the metro area might be in store for a significant snowfall.

Product Preparation

The PQSF product is created at the NWS Forecast Office in Buffalo, NY using Tcl/tk software running on a standard PC. Much of the original code was written by Ed Mahoney, currently at the NWS WDTB facility. The most recent version of the software was written by Tony Ansuini, a meteorologist at the NWS office in Buffalo.

Once the forecasters prepare the product, information is automatically sent to the NWS Buffalo Web site and is available from the Home Page under "PQSF Forecast".

How to read the PQSF

The forecast is composed of two charts that include:

- 1. "Probability of snow" chart. This chart shows the forecaster's expert opinion of the probability that a pre-determined range of snowfall will occur.
- 2. "Exceedance" chart. This chart shows the forecaster's expert opinion of the probability that snowfall will exceed certain values. The exceedance chart is derived from the probability chart. An example of a snowfall forecast and associated PQSF charts are shown below. In this example, the forecast for the Buffalo calls for "a 70% chance of snow, and correspondingly a 30% chance that no measurable snow will occur. "Measurable snow" is defined as anything greater than a trace. Given that 70% chance of snow, what are the potential outcomes that the forecaster believes could happen? They are represented in the PQSF charts.

Chart 1:

The probability of snow chart shows the following: 0/T (30%), T/2 (0%), 2/4 (20%), 4/6 (40%), 6/12 (10%), >12 (0%). This chart shows the forecasters best guess at the most likely snowfall amount given that snow will occur. The 70% chance of measurable snow is "spread out" over 3 categories with the most confidence placed in the 4 to 6 inch range.

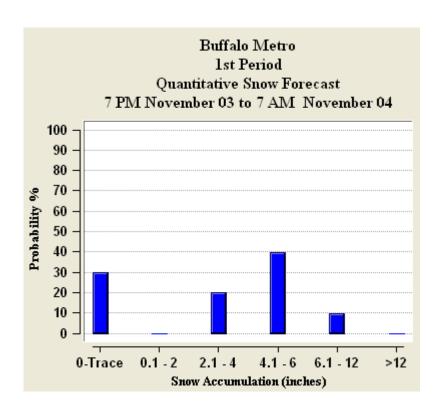
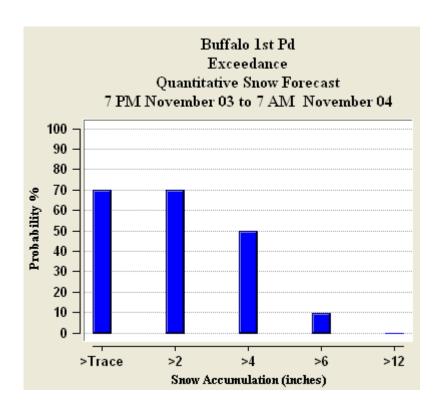


Chart 2: The exceedance chart shows the following: >T (70%), >2 (70%), >4 (50%), >6 (10%), >12 (0%).



Explanation: The first chart indicates that given a 70% chance of measurable snow occurring, that value is "spread out" over 3 potential outcomes. a 20% chance that 2 to 4 inches will fall, a 40% chance that 4 to 6 inches will occur and a 10% chance that 6 to 12 inches might occur. The spread in that 70% value is a graphical description of the forecaster's confidence level in his/her snowfall forecast.

The second chart indicates the forecaster's confidence that certain critical snowfall totals will be exceeded. This chart can provide excellent guidance to those who must take certain planning and decision-making steps when there is a likelihood that snowfall will exceed a certain value. Based on a 70% chance of snow, there is a 70% chance that greater than a Trace will occur, 70% chance that greater than 2 inches will occur, a 50 percent chance that greater than 4 inches will occur, a 10% chance that greater than 6 inches will occur and 0% chance that greater than 12 inches will occur. By using the two charts together, you can get a good idea of the range of possibilities the forecaster feels could happen.

Bar graphs are created for both Buffalo and Rochester. For chart 1, the x-axis shows the predetermined snowfall categories and the y-axis indicates the percentage chance that each category will occur. For chart 2, the x-axis shows the snowfall exceedance value and the y-axis indicates the percentage chance the snowfall value will be exceeded.

As one can see, chart 1 provides a type of "forecaster confidence" chart. The forecast possibilities might be limited to one category. However, in situations where multiple scenarios might be possible, the "conditional probability" portion of the PQSF may be spread over multiple categories as in the above example. A standard zone forecast might say that another 4 to 6 inches of snow is likely as metro Buffalo sits at the edge of a lake effect snow band. If the wind direction forecast is off by just a few degrees however, then the snow band will be located in a different place and one of the two other categories could occur. Chart 2 provides excellent guidance to those who must take certain planning and decision-making steps when there is a likelihood that snowfall will exceed a value. The two Probabilistic Quantitative Snowfall Forecast charts together give planning officials more information about the potential scenarios that might occur.